# In the United States Patent and Trademark Office



Appn. Number: _____

Appn. Filed: _____

Applicant(s): Herzinger et al.

Appn. Title: ODD BOUNCE IMAGE ROTATION SYSTEM IN ELLIPSOMETER SYSTEMS

Examiner/GAU: _____ /1724

Mailed: With Application

At: _____

#2
21Nov01
R. Talbert

## Information Disclosure Statement

Commissioner of Patents and Trademarks
Washington, District of Columbia 20231

Sir:

Attached is a completed Form PTO-1449 and copies of the pertinent parts of the references cited thereon.

Following are comments on these references pursuant to Rule 98:

IDENTIFIED PATENTS

Patent to Herzinger, No. 6,137,618 is disclosed as it describes a Single Brewster Angle Polarizer in the context of multiple reflecting means, and discloses prior art dual Brewster Angle Single Reflective Means Polarizer Systems.

Patent to Herzinger et al., No. 6,084,675 describes an adjustable beam alignment compensator/retarder with application to spectroscopic ellipsometry.

Patent No. 6,118,537 to Johs et al. describes a multiple Berek plate optical retarder system.

Patent No. 6,141,102 to Johs et al. describes a single triangular shaped optical retarder element.

Patent No. 5,946,098 to Johs et al., describes dual tipped wire grid polarizers in combination with various compensator/retarder systems.

Patent No. 6,100,981 to Johs et al., describes a dual Horizontally oriented triangular shaped optical retarder.

Patent No. 6,084,674 to Johs et al., describes a parallelogram shaped optical retarder element.

Patent No. 5,963,325 to Johs et al., describes a dual vertically oriented triangular shaped optical retarder element.

A Patent to Johs et al., No. 5,872,630 is disclosed as it describes an ellipsometer system in which an analyzer and polarizer are maintained in a fixed in position during data acquisition, while a compensator is caused to continuously rotate.

A Patent to Thompson et al. No. 5,706,212 is also disclosed as it teaches a mathematical regression based double Fourier series ellipsometer calibration procedure for application, primarily, in calibrating ellipsometers system utilized in infrared wavelength range. Bi-refringent, transmissive window-like compensators are described as present in the system thereof, and discussion of correlation of retardations entered by sequentially adjacent elements which do not rotate with respect to one another during data acquisition is described therein.

Further Patents of which the Inventor is aware include:

Nos. 5,757,494; and
5,956,145;

to Green et al., in which are taught a method for extending the range of Rotating Analyzer/Polarizer ellipsometer systems to allow measurement of DELTA'S near zero (0.0) and one-hundred-eighty (180) degrees, and the extension of modulator element ellipsometers to PSI'S of forty-five (45) degrees. Said Patents describes the presence of a variable, transmissive, bi-refringent component which is added, and the application thereof during data acquisition to enable the identified capability.

Patent to He et al., No. 5,963,327 is disclosed as it describes an ellipsometer system which enables providing a polarized beam of electromagnetic radiation at an oblique angle-of-incidence to a sample system in a small spot area.

Patents of general interest of which the Inventor is aware include:

Patent to Woollam et al, No. 5,373,359;
Patent to Johs et al. No. 5,666,201;
Patent to Green et al., No. 5,521,706; and
Patent to Johs et al., No. 5,504,582;

and are disclosed as they pertain to ellipsometer systems.

Patent to Coates et al., No. 4,826,321 is disclosed as it describes applying a reflected monochromatic beam of plane polarized electromagnetic radiation at a Brewster angle of incidence to a sample substrate to determine the thickness of a thin film thereupon. This Patent also describes calibration utilizing two sample substrates, which have different depths of surface coating.

Other Patents which describe use of reflected electromagnetic radiation to investigate sample systems are:

Nos. RE 34,783,
4,373,817,
5,045,704 to Coates; and
5,452,091 to Johnson.

Patent to Bjork et al., No. 4,647,207 is disclosed as it describes an ellipsometer system which has provision for sequentially positioning a plurality of reflective polarization state modifiers in a beam of electromagnetic radiation.

Patent Nos.

4,210,401;
4,332,476; and
4,355,903

are also identified as being cited in the 207 Patent. It is noted that systems as disclosed in these Patents, (particularly in the 476 Patent), which utilize reflection from an element to modify a polarization state.

Patent to Mansuripur et al., No. 4,838,695 is disclosed as it describes an apparatus for measuring reflectivity.

Patents to Rosencwaig et al., Nos.

4,750,822; and
5,595,406

are also identified as they describe systems which impinge electromagnetic beams onto sample systems at oblique angles of incidence. The 406 Patent provides for use of multiple wavelengths and multiple angles of incidence. For similar reasons Patent No.

5,042,951

to Gold et al. is also disclosed.

In addition to the identified Patents, certain Scientific papers are also identified.

A paper by Johs, titled "Regression Calibration Method for Rotating Element Ellipsometers", Thin Solid Films, 234 (1993) is also disclosed as it describes a mathematical regression based approach to calibrating ellipsometer systems.

A paper by Smith, titled "An Automated Scanning Ellipsometer", Surface Science, Vol. 56, No. 1. (1976), is also mentioned as it describes an ellipsometer system which does not require any

moving, (eg. rotating), elements during data acquisition.

A review paper by Collins, titled "Automatic Rotating Element Ellipsometers: Calibration, Operation and Real-Time Applications", Rev. Sci. Instrum., 61(8) (1990).

SINCERELY,

JAMES D. WELCH
REG. NO. 31,216

Sheet 1 of 4

Form PTO-1449 (Modified) — U.S. DEPARTMENT OF COMMERCE — PATENT AND TRADEMARK OFFICE

| ATTY. DOCKET NO. | SERIAL NO. |
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| APPLICANT: Herzinger et al. | |
| FILING DATE | GROUP |

09/963573 U.S. PTO 09/26/01

## LIST OF PRIOR ART CITED BY APPLICANT

*(Use several sheets if necessary)*

### U.S. PATENT DOCUMENTS

| EXAMINER INITIAL | | DOCUMENT NUMBER | DATE | NAME | CLASS | SUBCLASS | FILING DATE IF APPROPRIATE |
|---|---|---|---|---|---|---|---|
| | AA | 6137618 | 10/2000 | Herzinger | 359 | 245 | |
| | AB | 6084675 | 7/2000 | Herzinger et al. | 356 | 369 | |
| | AC | 6118537 | 9/2000 | Johs et al. | 356 | 369 | |
| | AD | 6141102 | 10/2000 | Johs et al. | 356 | 364 | |
| | AE | 5946098 | 8/1999 | Johs et al. | 356 | 364 | |
| | AF | 6100981 | 8/2000 | Johs et al. | 356 | 364 | |
| | AG | 6084674 | 7/2000 | Johs et al. | 356 | 364 | |
| | AH | 5963325 | 10/1999 | Johs et al. | 356 | 364 | |
| | AI | 5872630 | 2/1999 | Johs et al. | 356 | 369 | |
| | AJ | 5706212 | 1/1998 | Thompson et al. | 364 | 525 | |
| | AK | 5757494 | 5/1998 | Green et al | 356 | 369 | |

### FOREIGN PATENT DOCUMENTS

| | | DOCUMENT NUMBER | DATE | COUNTRY | CLASS | SUBCLASS | TRANSLATION YES | TRANSLATION NO |
|---|---|---|---|---|---|---|---|---|
| | AL | | | | | | | |
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### OTHER PRIOR ART (Including Author, Title, Date, Pertinent Pages, Etc.)

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APPLICANT Herzinger et al.

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| EXAMINER INITIAL | | DOCUMENT NUMBER | DATE | NAME | CLASS | SUBCLASS | FILING DATE IF APPROPRIATE |
|---|---|---|---|---|---|---|---|
| | AA | 5,495,614 | 9/1995 | Green et al. | 356 | 364 | |
| | AB | 5,963,327 | 10/1999 | He et al. | 356 | 369 | |
| | AC | 5,373,359 | 12/1994 | Woollam et al. | 356 | 328 | |
| | AD | 5,666,201 | 9/1997 | Johs et al. | 356 | 369 | |
| | AE | 5,521,706 | 5/1996 | Green et al. | 356 | 369 | |
| | AF | 5,504,582 | 4/1996 | Johs et al. | 356 | 369 | |
| | AG | 4,826,321 | 5/1989 | Coates et al. | 356 | 351 | |
| | AH | RE34,783 | 11/1994 | Coates | 250 | 372 | |
| | AI | 4,373,817 | 2/1983 | Coates | 356 | 384 | |
| | AJ | 5,045,704 | 9/1991 | Coates | 250 | 372 | |
| | AK | 5,452,091 | 9/1995 | Johnson | 356 | 445 | |

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| EXAMINER INITIAL | | DOCUMENT NUMBER | DATE | NAME | CLASS | SUBCLASS | FILING DATE IF APPROPRIATE |
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| | AA | 4,647,207 | 3/1987 | Bjork et al | 356 | 369 | |
| | AB | 4,210,401 | 7/1980 | Batten | 356 | 369 | |
| | AC | 4,332,476 | 7/1982 | Stenberg et al. | 356 | 369 | |
| | AD | 4,355,903 | 10/1982 | Sandercock | 356 | 382 | |
| | AE | 4,838,694 | 7/1989 | Manuccipur et al. | 356 | 369 | |
| | AF | 4,750,822 | 7/1988 | Rosencwaig et al. | 356 | 445 | |
| | AG | 5,596,406 | 1/1997 | Rosencwaig et al. | 356 | 327 | |
| | AH | 5,042,951 | 8/1991 | Gold et al. | 356 | 369 | |
| | AI | | | | | | |
| | AJ | | | | | | |
| | AK | | | | | | |

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Hertinger et al.

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"Regression Calibration Method for Rotating Element Ellipsometers", Johs, Thin Solid Films, 234 (1993).

"An Automated Scanning Ellipsometer", Smith, Surface Science, Vol. 56, No. 1. (1976).

"Automatic Rotating Element Ellipsometers: Calibration, Operation and Real-Time Applications", Collins, Rev. Sci. Instrum., 61(8) (1990).